FIRST SUPPLEMENT TO BULLETIN NO. 1042 AUGUST 1, 1909

THE DENVER ENGINEERING WORKS CO.

RICHARDS PULSATOR CLASSIFIER

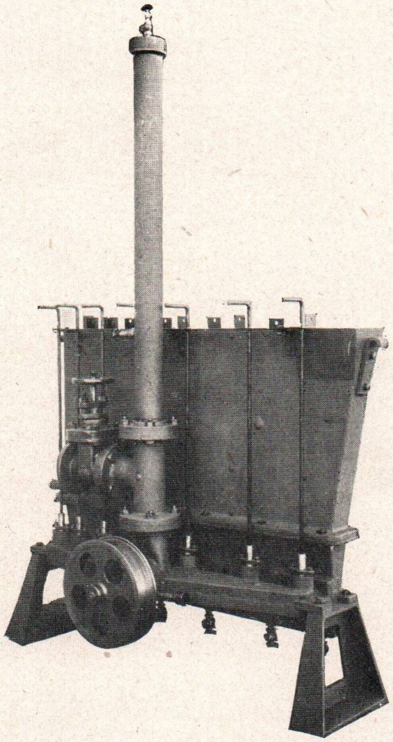

FIG. 771

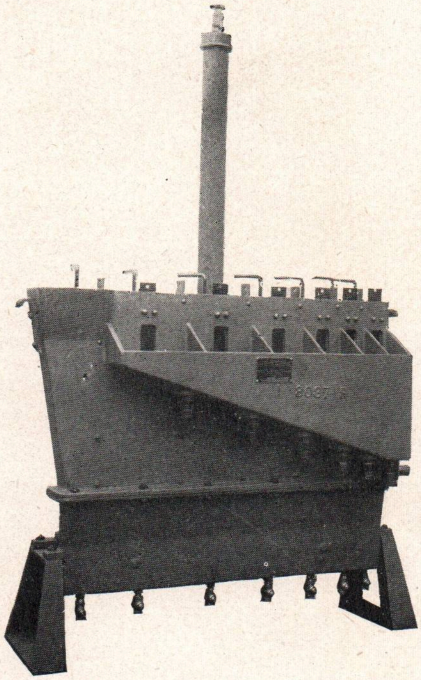

FIG. 772

100-TON 6-COMPARTMENT RICHARDS PULSATOR CLASSIFIER

This supplement sets forth some interesting facts and figures pertaining to installations of the Richards Pulsator Classifier.

EL TIRO COPPER COMPANY

This company is located at Silverbell, Pima County, Arizona. The report hereinafter given is based upon the operation of a standard 4-inch 6-compartment Richards Pulsator Classifier, of the inverted type, in a small mill wherein experiments are being carried out for the purpose of selecting the best apparatus and process to be used in a large mill, which the company will erect in the near future. In considering the report two things should be borne in mind: First, the tonnage handled in this experimental mill is sufficient from which to accurately judge metallurgical results attainable upon a commercial operating basis; second, while in the matter of screen versus classifier the classifier excels (as the author states), operating conditions in an experimental installation are more favorable for the screens than in a large commercial installation and hence the victory of the classifier over screens at this particular installation is a most decided one. The following article appeared in "Mines and Minerals" of January, 1909, and is reproduced by courtesy of the publishers. The italics are our own:

CLASSIFICATION AT EL TIRO MILLS

Pima County, Arizona—Working Results of the Richards Pulsator Classifier—Comparison of Classified with Screen Sized Material

Written for "Mines and Minerals," by George W. Brown, Mill Superintendent

The Richards Pulsator Classifier, perfected by Prof. Robert H. Richards, of the Massachusetts Institute of Technology, undoubtedly marks a distinct advance in the science of ore dressing, for of all the problems encountered in concentration, the one of suitable classification has been the most troublesome and until the advent of this classifier, the least satisfactorily overcome.

It is not intended in this article to go into the details or theory of its construction; suffice it to say, the principle involved is that the pulp is subjected to the action of a pulsating flow of water delivered under pressure, producing partial suspension, which flow has a graded increase of speed in successive compartments as the pulp proceeds through the machine. This graded speed is due to the decreased size of each succeeding compartment, so that assuming that each is receiving exactly the same amount of water, any one of them has a stronger flow than the one preceding it. This condition of flow, however, is entirely within the control of the operator and, within certain limits, the size or quantity of pulp desired can be discharged from any particular compartment.

TABLE I. SIZE AND MESH OF SCREENS USED.

NO OF SCREEN	Mesh	Opening in Inches	Opening in Millimeters
1	10	.78	2.00
2	20	.039	1.00
3	30	.024	.61
4	40	.0112	.30
5	80	.00675	.17
6	100	.00550	.14
7	150	.00360	.092
8	200	.00300	.077

Another feature of the machine is the successively decreased height of the discharge gates which are also adjustable and can be made to govern the speed at which the pulp travels through the machine, giving to it a wide range of capacity. For example, the 4-inch machine credited with a maximum capacity of 200 tons per 24 hours, can be regulated to classify 30 tons in an entirely satisfactory manner by adjusting the line of discharge gates to a given level, in so far as the openings permit. This adjustment is made by lowering the discharge gate of compartment No. 1 to its lowest limit and raising that of compartment No. 6 to its highest limit, then setting the intermediate gates to the level of an imaginary line connecting these two. This adjustment reduces the capacity of the machine so that if a smaller quantity of pulp containing an excess of slimes and fines is fed the machine than the quantity called for by the rated capacity of the machine, it will effect as thorough a classification as though fed to its full capacity. By raising the gates, the progress of the pulp is impeded, causing an increased thickness of the bed of coarse mineral particles which results in a decreased discharge over the gates while the slimes and fines are drawn off from the first two compartments as before.

At the mill of the El Tiro Co. is a standard 4-inch machine rated by Professor Richards *at from 150 to 200 tons per 24 hours.* By making the adjustments above noted, the thickness of the bed on the sieve was made equal to that carried under full capacity and the capacity of our machine was successfully reduced to *30 tons per 24 hours at which it did satisfactory work.* The results given below were attained on a porphyritic ore, carrying disseminated black oxide of copper averaging approximately 2.25 per cent. copper, the mineral being exceedingly soft and easily slimed.

In order to make a comparative series of tests of the relative merits of screen sizing and classifier sizing, two quantities of the same ore were crushed under exactly similar conditions.

Table 1 shows size and mesh of screens used:

A screen analysis of a representative quantity of the crushed ore gave the following:

Through screen No. 1, on screen No. 2, 40 per cent., no free mineral, all reground; through screen No. 2, on screen No. 3, 21 per cent., table tailings reground; through screen No. 3, on screen No. 4, 14 per cent., table tailings to waste; through screen No. 4, on screen No. 5, 10 per cent., table tailings to waste; through screen No. 5, 15 per cent., table tailings to waste.

The 40 per cent. of the crushed ore passing screen No. 1 but caught on screen No. 2 (20 mesh or 1 millimeter) contained no free mineral but enough disseminated mineral to require recrushing before sending to the concentrating tables.

The next finer sized material caught on screen No. 3 (30 mesh or .61 millimeter) and comprising 21 per cent. of the total quantity, after concentration on the tables had so much mineral in the tailings as to necessitate regrinding. The tailings from the tables treating the finer sizes were sent to waste.

Thus the method of *screen sizing* the mineral before table concentration *required the regrinding of 61 per cent.* of the total before attaining the desired per cent. recovery.

To obtain this same recovery using the *Richards Pulsator Classifier* instead of the screens, *it was found necessary to regrind but 46 per cent. of the total* concentrating table tailings and the feed for these particular tables came from classifier compartments No. 5 and No. 6. The reduction in the amount of material to be reground is apparent in the screen analysis below where it is seen that a considerable portion of coarse material, practically valueless (below 1 per cent. copper) was drawn from compartments Nos. 3 and 4. The advantage of using the classifier over the screen is thus apparent.

From the accompanying screen analyses, made by the writer, the character of the work of the classifier is made apparent.

	Discharge from											
	Compartment 1		Compartment 2		Compartment 3		Compartment 4		Compartment 5		Compartment 6	
Size of Screen	Per Cent. on Screen	Per Cent. Copper	Per Cent. on Screen	Per Cent. Copper	Per Cent. on Screen	Per Cent. Copper	Per Cent. on Screen	Per Cent. Copper	Per Cent. on Screen	Per Cent. Copper	Per Cent. on Screen	Per Cent. Copper
2					6.00	.76	12.00	.55	52.00	.67	62.00	1.32
3			5.00	.60	23.50	.78	36.00	.84	40.00	1.51	29.50	1.66
4	8.20	.60	30.00	.77	49.00	1.01	37.35	.94	7.40	6.00	7.00	5.80
5	22.70	1.02	29.00	1.50	15.50	4.14	11.00	5.94			1.20	15.24
6	13.70	1.35	7.50	2.40	2.50	8.34	1.50	9.50				
7	10.20	1.79	10.00	2.55	2.50	10.02	2.50	7.74				
8	10.50	2.19	5.00	3.36								
9	35.00	1.95	15.00	1.98								

The test from which these analyses were taken was made in part to determine how early in the process all slimes could be drawn off. As shown by the table, this was done in the first two compartments. *The water discharging from the last four was quite clear and practically free of mineral too fine to be recovered from the associated coarser quartz grains. The only apparent free mineral loss took place on the tables receiving the discharges of the first two compartments.*

It is a matter of general knowledge that classification effects a greater saving in proportion as it approaches the theoretically perfect, therefore it is useless to compare recoveries made by treating classified as against unclassified material. We have, however, made the tests noted above, to compare material classified with the Richards pulsator, with screen-sized material. As a result we found that there was practically *no choice between them from the standpoint of recovery made, but when cost of installation, power, and maintenance are considered, the classifier has much the best of it.* No assumption is intended that this will hold true as a general proposition with all ores and under all conditions, for it most probably would not. In any event it is the wisest procedure to determine this in each particular instance.

In conclusion I might sum up the advantages of this machine as follows: Small floor space required; small loss of mill head; wide range of capacity and the delivery of six products. This last is by far the most important, for not only is the pulp divided into six classes, but is also segregated in such a way that that part of the pulp which might be further treated after passing the concentrators is separately available, *i. e.*, the table tailings of the coarse sizes might be profitably reground, while the finest can be sent on to the slime plant. *In short, it opens a wider field for the chasing of values, and will surely lower the "irreducible minimum" below which it would be unprofitable to follow.* It must be understood, however, that this machine, admirable as it is, cannot entirely overcome the ill effects of poorly advised methods of grinding, or subsequent treatment of its product. It will work to best advantage only when the general scheme of treatment is logical, from the entrance of the ore into the mill, to its exit by way of the concentrates bin and waste tailings launder.

SANTA RITA MINING COMPANY

This company operates at Santa Rita, near Silver City, New Mexico. The following data, compiled by Mr. John M. Sully, manager, shows very clearly the work of the Wilfley tables following our classifier on a copper ore crushed to pass 20 mesh screens. The report is of great interest as it shows the work of the classifier on finely crushed ores, and is worth the very careful study that is required to fully comprehend just what is shown therein.

TEST ON CHINO DUMP — MARCH 3RD 1909
SANTA RITA MINING CO.
RICHARDS PULSATOR CLASSIFIER — WILFLEY CONCENTRATING TABLES
GENERAL FEED SAMPLE 2.33% CU. GENERAL TAILS SAMPLE 0.49% CU.

CLASSIFIER DISCH. No.	TABLE No.	CLASS		ORIGINAL SAMPLE BY ASSAY	BY CALCULATION	+20 MESH	-20+30 MESH	-30+40 MESH	-40+50 MESH	-50+60 MESH	-60+80 MESH	-80+100 MESH	-100+150 MESH	-150+200 MESH	-200 MESH	CONCTS %CU.
6	1	FEED	% SIZE	100	——	TRACE	36	15	22	13	5	+8	——	——	——	17.9
"	"	"	% CU.	2.22	2.03	——	0.99	1.25	1.98	3.06	3.71	5.84	——	——	——	
"	"	"	% TOTAL CU. BY WEIGHT	——	100	——	17.6	9.2	21.5	19.6	9.1	23.0	——	——	——	
"	"	TAILS	% SIZE	100	——	TRACE	41	18	23	11	4	+3	——	——	——	
"	"	"	% CU.	0.36	0.36	——	0.30	0.38	0.44	0.40	0.36	0.40	——	——	——	
"	"	"	% TOTAL CU. BY WEIGHT	——	100	——	33.9	18.8	27.9	12.1	4.0	3.3	——	——	——	
"	2	FEED	% SIZE	100	——	TRACE	30	12	23	14	6	6	5	+3	——	17.1
"	"	"	% CU.	2.51	2.65	——	1.81	1.60	2.28	2.97	3.54	5.09	5.63	5.95	——	
"	"	"	% TOTAL CU. BY WEIGHT	——	100	——	20.5	7.2	19.8	15.7	8.0	11.5	10.6	6.7	——	
"	"	TAILS	% SIZE	100	——	TRACE	34	18	23	14	5	+5	——	——	——	
"	"	"	% CU.	0.42	0.36	——	0.32	0.40	0.44	0.36	0.34	0.27	——	——	——	
"	"	"	% TOTAL CU. BY WEIGHT	——	100	——	30.0	19.8	27.9	13.9	4.7	3.7	——	——	——	
5	3	FEED	% SIZE	100	——	TRACE	22	12	22	19	7	7	7	+4	——	16.3
"	"	"	% CU.	1.98	1.65	——	0.85	0.82	1.03	1.58	2.43	2.80	4.38	5.21	——	
"	"	"	% TOTAL CU. BY WEIGHT	——	100	——	8.7	6.0	13.7	18.2	10.3	11.9	18.6	12.6	——	
"	"	TAILS	% SIZE	100	——	TRACE	27	13	23	18	6	6	+7	——	——	
"	"	"	% CU.	0.38	0.34	——	0.23	0.38	0.38	0.42	0.42	0.34	0.34	——	——	
"	"	"	% TOTAL CU. BY WEIGHT	——	1.00	——	18.1	14.4	25.4	22.0	7.3	5.9	6.9	——	——	
"	4	FEED	% SIZE	100	——	——	21	14	24	16	8	8	5	+6	——	12.8
"	"	"	% CU.	2.26	1.92	——	0.86	1.20	1.41	1.94	2.79	2.86	4.10	4.43	——	
"	"	"	% TOTAL CU. BY WEIGHT	——	100	——	9.4	8.8	17.7	16.0	11.6	11.9	10.7	13.9	——	
"	"	TAILS	% SIZE	100	——	TRACE	23	15	23	20	7	7	+8	——	——	
"	"	"	% CU.	0.29	0.32	——	0.34	0.36	0.32	0.32	0.19	0.23	0.28	——	——	
"	"	"	% TOTAL CU. BY WEIGHT	——	100	——	24.8	17.1	23.3	20.2	4.2	5.1	5.3	——	——	
4	5	FEED	% SIZE	100	——	——	10	9	20	18	10	11	11	5	6	15.1
"	"	"	% CU.	1.92	1.83	——	0.55	0.68	0.87	1.22	1.79	2.13	3.59	4.85	4.52	
"	"	"	% TOTAL CU. BY WEIGHT	——	100	——	3.0	3.3	9.5	12.0	9.8	12.8	21.5	13.2	14.8	
"	"	TAILS	% SIZE	100	——	TRACE	18	10	21	17	8	9	9	+8	——	
"	"	"	% CU.	0.57	0.34	——	0.34	0.30	0.30	0.36	0.42	0.42	0.23	0.42	——	
"	"	"	% TOTAL CU. BY WEIGHT	——	100	——	17.9	8.8	18.4	17.9	9.9	11.1	6.1	9.9	——	
3	6	FEED	% SIZE	100	——	——	TRACE	5	8	15	9	17	24	8	15	16.3
"	"	"	% CU.	1.75	1.81	——	——	0.81	0.65	0.59	0.80	1.16	2.47	3.50	3.36	
"	"	"	% TOTAL CU. BY WEIGHT	——	100	——	——	1.7	2.9	4.9	3.9	10.8	32.8	15.4	27.8	
"	"	TAILS	% SIZE	100	——	——	TRACE	6	11	17	9	18	23	7	10	
"	"	"	% CU.	0.32	0.34	——	——	0.28	0.25	0.28	0.30	0.30	0.34	0.25	0.64	
"	"	"	% TOTAL CU. BY WEIGHT	——	100	——	——	5.0	8.2	14.2	8.0	16.1	23.3	5.2	20.0	
1+ STEEL TANK PULP	7	FEED	% SIZE	100	——	——	——	TRACE	2	5	5	11	26	14	36	15.6
"	"	"	% CU.	1.41	1.43	——	——	——	0.95	0.57	0.48	0.51	0.99	1.57	2.28	
"	"	"	% TOTAL CU. BY WEIGHT	——	100	——	——	——	1.3	2.0	1.7	3.9	18.0	15.4	57.7	
"	"	TAILS	% SIZE	100	——	——	——	——	TRACE	6	3	12	18	13	46	
"	"	"	% CU.	0.84	0.85	——	——	——	——	0.89	0.61	0.44	0.36	0.42	1.31	
"	"	"	% TOTAL CU. BY WEIGHT	——	100	——	——	——	——	6.3	2.2	6.2	7.7	6.5	71.1	
2	8	FEED	% SIZE	100	——	——	——	——	TRACE	5	8	16	27	16	28	8.0
"	"	"	% CU.	1.25	1.53	——	——	——	——	0.33	0.40	0.57	0.99	1.71	3.02	
"	"	"	% TOTAL CU. BY WEIGHT	——	100	——	——	——	——	1.1	2.1	6.0	17.5	17.9	55.4	
"	"	TAILS	% SIZE	100	——	——	——	——	TRACE	9	9	15	28	8	30	
"	"	"	% CU.	0.59	0.63	——	——	——	——	0.33	0.36	0.36	0.42	0.49	1.18	
"	"	"	% TOTAL CU. BY WEIGHT	——	100	——	——	——	——	4.8	5.2	8.6	18.8	6.1	56.5	
STEEL TANK PULP	9	FEED	% SIZE	100	——	——	——	——	——	——	2	6	16	16	60	10.2
"	"	"	% CU.	1.23	1.23	——	——	——	——	——	(0.70)		0.55	0.68	1.63	
"	"	"	% TOTAL CU. BY WEIGHT	——	100	——	——	——	——	——	4.6		7.1	8.8	79.5	
"	"	TAILS	% SIZE	100	——	——	——	——	——	——	——	4	24	21	51	
"	"	"	% CU.	0.70	0.71	——	——	——	——	——	——	0.67	0.40	0.38	1.00	
"	"	"	% TOTAL CU. BY WEIGHT	——	100	——	——	——	——	——	——	3.8	13.5	11.2	71.5	
STEEL TANK OVERFLOW	10	FEED	% SIZE	100	——	——	——	——	——	——	TRACE	4	6	6	84	7.6
"	"	"	% CU.	1.58	1.60	——	——	——	——	——	——	(1.56)		(1.60)		
"	"	"	% TOTAL CU. BY WEIGHT	——	100	——	——	——	——	——	——	9.8		90.2		
"	"	TAILS	% SIZE	100	——	——	——	——	——	——	TRACE	12	6	8	72	
"	"	"	% CU.	1.33	1.33	——	——	——	——	——	——	1.46	1.27	1.18	1.37	
"	"	"	% TOTAL CU. BY WEIGHT	——	100	——	——	——	——	——	——	13.2	5.7	7.0	74.1	

DENVER ENGINEERING WORKS CO.
3/27/09

The classifier is a standard 4-inch 6-compartment machine of the inverted type. Discharge No. 6 is therefore the coarsest product of the classifier.

Despite the fineness of the feed, note the absence of fine free mineral in the tailings of table No. 1 to 6 inclusive. This shows clearly the elimination of fine free mineral from the tailings that is accomplished by the pulsator classifier under proper operating conditions, and the consequent fact: that only by recrushing could any further saving be effected.

As an example, consider the tailings of table No. 4. If we assume the general sample of these tailings as 1,000 lbs. then the total sample contains but 32 pounds of copper while the portion of these tailings that passes through a 60-mesh screen carries but 4.2% + 5.1% + 5.3% = 14.6% of 32 lbs. = 4.672 lbs. of copper out of 1,000 lbs. of tailings is lost in material finer than 60 mesh.

We can conceive of no more conclusive proof, than that set forth in this table, of our claim that the pulsator classifier will eliminate absolutely fine free mineral from coarse table tailings.

To the mill superintendents who are not content to accept any old assay of tailings as an "irreducible minimum" on their particular ore we suggest a corresponding analysis of the feed and tailings of their tables, with full confidence that they will either find fine mineral going to waste with coarse tailings or that they are regrinding a lot of material wherein the values are already free from the gangue. The correction of either of these conditions is the installation of a Richards Pulsator Classifier.

In connection with Mr. Sully's report, the following extracts from his letters will also be of interest.

March 4, 1909. "The classifier has been doing most excellent work for us."

March 31, 1909. "I have noted the surprising saving in the meshes between 40 and 100. It seems to hold true on every test that we have made, on all classes of ore."

April 23, 1909. "Our boys who are handling the classifier in the mill have attained great proficiency in it, and I am satisfied that a test on it at this time would show even better results than those sent you * * *. I feel more than satisfied with the results that we have accomplished in this mill in connection with the use of Dr. Richards' two machines."

BOSTON & MONTANA C. C. & S. M. CO.

This company operating at Great Falls, Montana, purchased one standard 4-inch 6-compartment pulsator classifier April 6, 1907. Three more machines of the same size and type were ordered November 18, 1907. We are not at liberty to give any figures in connection with this company's mill practice, but the repeat order is evidence of the satisfaction given by the machines in operation.

In this installation the classifiers are fed with the undersize of 2½ m.m. trommels. (Approx. 5 mesh.) Consideration of the work on the undersize of 10-mesh screens at the El Tiro mill; on the undersize of 20-mesh screens at the Santa Rita mill; on the undersize of 2½ m.m. screens at the Boston & Montana mill, shows the wide range of sizes successfully treated by these machines.

In a letter to Prof. Henry S. Munroe, under date of February 10, 1909, Mr. Charles W. Goodale, general manager of the Boston and Montana C. C. & S. M. Co., says:

> "The classifiers were first installed with the belief that they would do better work than the * * * type of classifier, which was in general use in our concentrator, and was treating the undersize of 2½ m.m. trommels and the Huntington mill product, making four jig classes, and an overflow slime for the Wilfley tables. As first installed, the six different classes from the Richards machine were treated on six separate Wilfley tables. The tailing from the coarser sizes going to the Huntington mills for recrushing, and the finer sizes giving tailing which was run over * * * screens, 50 mesh, the oversize from which was found to be too low grade for further treatment, but the undersize went to Frue vanners where an important additional saving was made. After a few months experience it was found that the coarse sizes, which were naturally just under 2½ m.m., that being the screen which prepared the feed for the classifier, were too coarse for the Wilfleys, the cutting and wearing of the riffles and decks being excessive. Harz jigs were then installed for treating these coarse sizes, and are giving very clean concentrate, with tailing carrying included grains and requiring further crushing.
>
> "The points of advantage of the pulsator classifier over the * * * are as follows:
>
> "1st. Better classification. This enables us to send to jigs or tables only that size of grains which the different kinds of machines are adapted to handle, and avoids as far as possible the recrushing of mineral grains which are already free.
>
> "2nd. Less water than with the * * * classifier, thereby giving a reduced volume of slime to be treated or settled."

In another letter written to Dr. Richards, under date of January 28, 1909, Mr. Goodale says: "Mr. H. D. McLeod wrote me, under date of January 11, asking for the latest information regarding the classifier * * *. I have replied to Mr. McLeod's letter * * * and have strongly endorsed the classifier."

BRITANNIA MINING AND SMELTING CO.

This company operates at Britannia Beach, British Columbia, and in remodeling their concentrating mill installed three 4-inch 6-compartment pulsator classifiers of the inverted type. These machines were shipped January 30, 1909.

Their ore is crushed to pass ¾-inch round holes, then screened for jigs and the undersize of the 1 m.m. (Approx. 12 mesh) screens goes to the classifiers. Coarse jig middlings are recrushed to pass ¼ inch, and the 1 m.m. and finer from these also goes to the classifier while the medium jig middlings are crushed to pass 2 m.m. and go directly to the classifiers.

In a letter of March 4, 1909, to Dr. Richards, Mr. Robert H. Leach, general superintendent of the Britannia M. & S. Co., says: "In my opinion the Richards Jig and Pulsator

Classifiers will do far more for the art of ore dressing than the reciprocating table has done."

In another letter of July 9, 1909, also to Dr Richards, Mr. Leach says, "and beg to state that the classifiers are doing most excellent work."

CASHIER MINING AND MILLING CO.

This company operated at Camp Albion, Boulder County, Colorado. The ore carries gold, silver and lead, while gangue is of a complex nature. Concentration methods prior to the installation of a Richards Pulsator Jig and a 4-inch 6-compartment Richards Pulsator Classifier did not yield satisfactory returns. In a telegram sent in answer to an inquiry as to the merits of the Richards apparatus, Mr. Thomas L. Wood, manager, stated that the apparatus had solved the problem of successfully concentrating their difficult ore.

Their ore averages from 8 to 10 per cent. lead. The following assays of table products furnished by Mr. Wood, are of interest:

Table Concentrates—42.2% Pb., 21 oz. Ag., 0.7 oz. Au.
Table Tailings—Trace Pb., 0.6 oz. Ag., 0.2 oz. Au.
Middlings—6.6% Pb., 3.8 oz. Ag., 0.4 oz. Au.

TOMBSTONE CONSOLIDATED MINES, Ltd.

With reference to the operation of a standard 2-inch 6-compartment Richards Pulsator Classifier in operation at this company's plant at Tombstone, Arizona, the mill foreman, Mr. John H. Kohler, reports: "We are separating lead, zinc and iron and get the zinc up to 45 per cent. Richards Pulsator Classifier is surely a wonderful little machine and we could hardly do without it in our plant here."

We are informed that prior to installation of the classifier it was impossible to obtain a zinc concentrate assaying higher than 19 per cent.

TOMBOY GOLD MINES, Ltd.

The ore which this company treats in its 60-stamp mill at Telluride, Colorado, is of a very complex nature, as it carries free gold, silver and lead values as well as zinc blendes and iron.

About three years ago especial attention was given the preparation of the feed to the concentrating tables and for this purpose there were installed:

3 Belt and Bucket Elevators, each 55 feet c to c.
6 50-Mesh Special Screens, with no reserve.
6 120-Mesh Special Screens, with no reserve.

Owing to cost of maintenance upon the elevator and screens a standard 4-inch 6-compartment Richards Pulsator Classifier was purchased for experimental purposes in May, 1908. At first there was some doubt whether the classifier would operate successfully on this very fine pulp, but after several months experimental work, three more classifiers were installed and the elevators and screens were torn out.

The installation at the Tomboy, therefore, now consists of

3 Spiral Sand Pumps, working against approx. 18 ft. head.
2 4-inch 6-compartment Richards Pulsator Classifiers, in use.
2 4-inch 6-compartment Richards Pulsator Classifiers, in reserve.

At a conservative estimate the previous installation of elevator and screens must have cost not less than $8,000.00 installed, and involved no reserve apparatus, while the pumps and Richards Pulsator Classifiers cost not more than $5,500.00 installed, including the reserve classifiers.

In July, 1909, Dr. Richards visited the Tomboy mill and found that despite the fineness of the pulp fed to classifiers, the classified feed to tables treating discharges No. 6, 5 and 4 carried no slimes whatever, the table performances as a whole being as follows:

TABLE ON DISCHARGE NO. 6. Feed carries no slimes. Tailings screened on 100-mesh screen. Undersize vanned and showed no free mineral.

TABLE ON DISCHARGE NO. 5. Feed carries no slimes. Tailings screened on 200-mesh screen. Undersize vanned and showed no free mineral.

TABLE ON DISCHARGE NO. 4. Same result as on table treating No. 5.

TABLE ON DISCHARGE NO. 3. Feed carried small amount of slime. Tailings screened on 200-mesh screen. Undersize vanned and showed a small proportion of mineral.

TABLE ON DISCHARGE NO. 2 AND 1. These Wilfley tables receive most of the slimes which are discharged as so-called "dirty head water," and are susceptible to further treatment by slime table, after thickening.

The classifiers at this installation also produce, as a hutch product, a very high concentrate which assays 12 oz. gold, 50% lead, 5% zinc, 4% silica. It will thus be seen that the classifiers at the Tomboy mill have three different functions, each of great value in itself, as follows:

FIRST—They feed the tables with six separate and distinct classes of pulp, three of which carry no slimes whatever.

SECOND—They save a great deal of valuable amalgam which has escaped the plates, the special amalgamators and the mercury traps, and which would probably be lost to a considerable extent if fed to the tables.

Third—They produce a very high-grade shipping concentrate directly from the hutches.

UNITED RICO MINES CO.

The ore which this company treats in its mill at Rico, Colorado, is of a very complex nature, as shown by assay of the feed to the classifier, hereinafter given. A standard 4-inch 6-compartment Richards Pulsator Classifier was installed in the latter part of 1908. Unfortunately the mill was partially destroyed by fire five days after the classifier was put in operation, and in all probability the operators had not become sufficiently conversant with the machine to arrive upon the best adjustment thereof for their particular ore during the five days the machine was in operation.

Nevertheless the results obtained were highly satisfactory, and the table treating discharge No. 3 produced a zinc concentrate which assayed 42 per cent. zinc—a thing not heretofore accomplished on Rico ores without magnetic separation of the zinc and iron values.

The following assays of the classifier feed and product at the mill, were furnished by Mr. J. M. McClave and are of great interest. Note the preponderance of lead values in the coarse products and of zinc values in the fine products:

	LEAD.	ZINC.	IRON.	INSOLUBLE.
Feed to Classifier	10.0%	24.3%	10.5%	12.7%
Discharge No. 1	9.9	23.8	11.0	14.0
Discharge No. 2	11.2	22.8	11.1	12.6
Discharge No. 3	8.7	23.0	11.0	14.1
Discharge No. 4	4.2	22.6	9.3	25.4
Discharge No. 5	9.2	23.6	14.6	15.2
Discharge No. 6	32.9	17.3	14.9	2.5
Safety Spigot or Discharge No. 7	43.9	12.5	12.7	2.4

The assays thus given show how the classifier, by its jig-like action, increases the lead content in the feed to coarse tables and this should be of particular interest to those who mill ores which are low in lead content.

The enrichment of the feed to the coarse tables insures that these tables will produce a high-grade concentrate for which a correspondingly high price per unit will be paid by the ore purchaser.

For instance, we know of one mill treating a complex ore averaging about 1½ per cent. lead and producing concentrates which average 20 per cent. lead. Now if by means of a Richards Pulsator Classifier, a part of this lead were recovered as a 40 per cent. concentrate, the shipper would be paid 51 cents per unit less a treatment charge of only $2.50 per ton, whereas as it is, he receives but 45 cents a unit less a treatment charge of $4.50 per ton for all of his lead concentrates.

At time of publication of this supplement, the United Rico Mines Company is preparing to place its mill in operation, and very interesting results from the classifier are anticipated.

UNIVERSITY OF TORONTO

The laboratory of this university, at Toronto, Canada, is equipped with a 2-inch 6-compartment Richards Pulsator Classifier of the direct type, and with a 2-inch 6-compartment Richards Pulsator Jig. These machines were shipped in December, 1908. In a letter to Dr. Richards, under date of May 25, 1909, Professor H. E. T. Haultain says: "I was extremely pleased with both machines and told my classes that these machines were epoch marking and would probably have a greater effect on the art of ore dressing than even the introduction of the Wilfley table."

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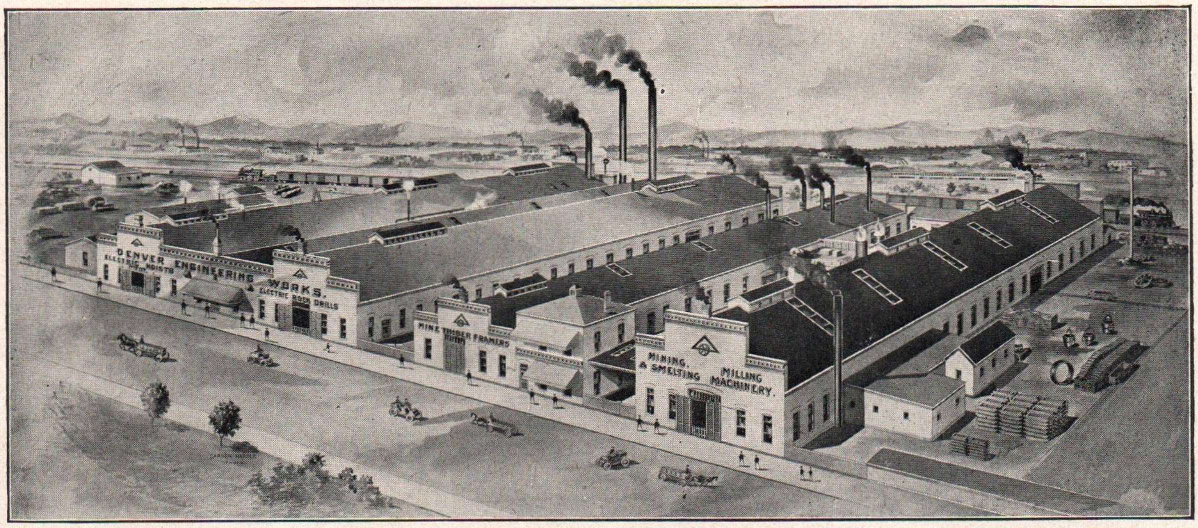

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